



NWIS Web Services Geodatabase Snapshot Tool for ArcGIS 10: Colorado Mineral Belt Case Study

United States Geological Survey
Austin, Texas
August 10, 2011

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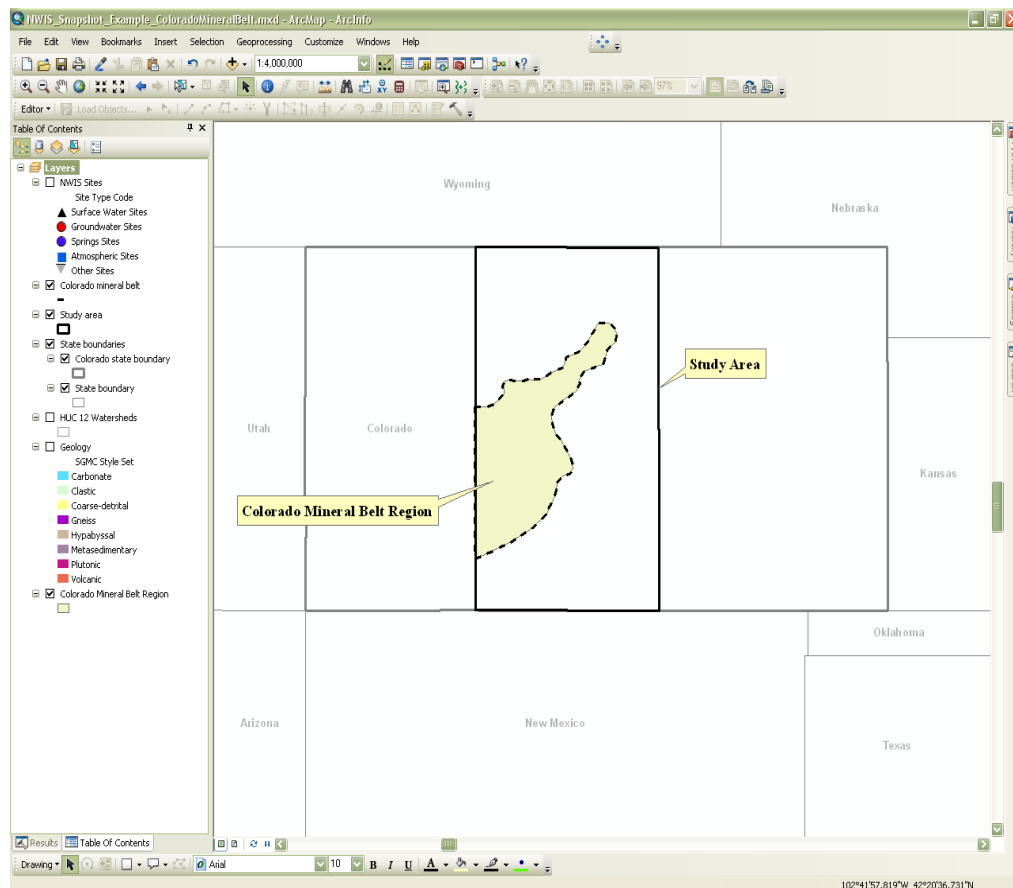
Tutorial: Colorado Mineral Belt Case Study

This tutorial is based on research documented in a report titled “Geochemistry of surface water in alpine catchments in central Colorado, USA: Resolving host-rock effects at different spatial scales” by Richard B. Wanty, Philip L Verplanck, Carma A. San Juan, Stanley E. Church, Travis S. Schmidt, David L. Fey, Ed H DeWitt, and Terry L. Klein.

In their study, Wanty and co-authors carried out a sampling program to evaluate regional environmental geochemistry in the context of catchment lithology. This research was in an area of Colorado known as the Colorado mineral belt—an area of significant historical mining activities, which is reflected in water quality analysis for the area (Figure 1). For this project, the researchers used geographic data such as catchment areas, and lithologic groups derived from regional-scale geologic maps with water quality samples they collected in the field to resolve host-rock effects at different spatial scales.

For this tutorial, we will learn how to use the NWIS Snapshot Tool to load water quality monitoring sites that might be used for a study of this nature. We will also find out how to narrow the number of sites we are interested in to a specific area, namely the sites within the Colorado mineral belt which are monitoring Strahler level 1 and 2 streams. We will also use geologic data to identify the lithologic groups for headwaters of streams in our case study.

Figure 1. Study area and location of Colorado mineral belt.



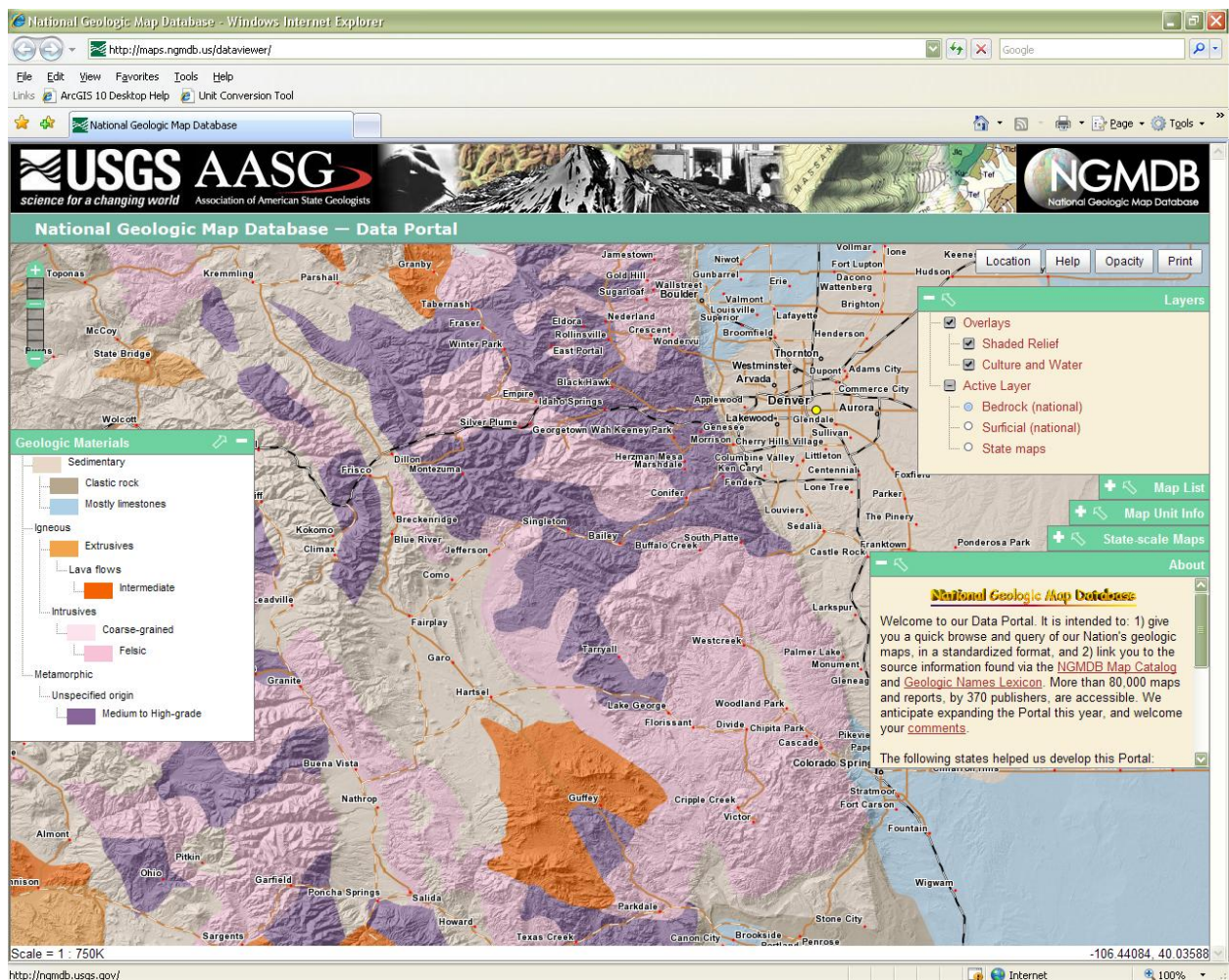
Acquiring Base Layers

This tutorial uses USGS GIS base layers acquired for hydrology and geology. You can acquire these data from the location described in the following sections.

Geology

One of the many Web sites the USGS hosts is a Web site that provides access to the National Geologic Map Database, which is available from: <http://ngmdb.usgs.gov> (Figure 2). This Web site is a resource for maps and related data about geology, hazards, earth resources, geophysics, geochemistry, geochronology, paleontology, and marine geology. Using the Interactive Data Portal tool, you can easily review available data and download what you need.

Figure 2. National Geologic Map Database – Data Portal <http://ngmdb.usgs.gov>

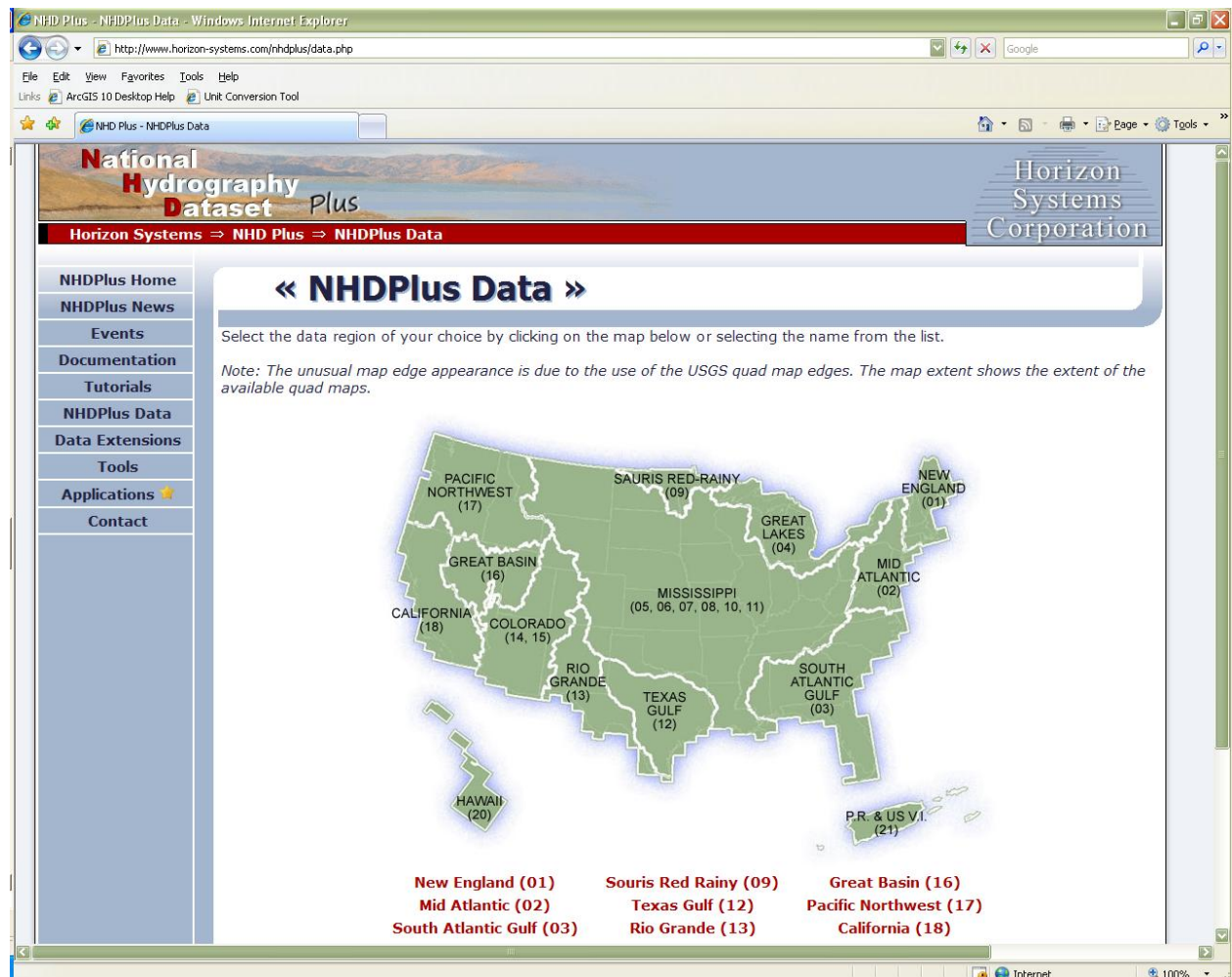


NHDPlus Streams

The USGS also hosts a website through Horizon Systems to allow access to NHDPlus Hydrography data (<http://www.horizon-systems.com/nhdplus/>) (Figure 3). The NHDPlus dataset provides quite a bit of information in one package, including:

- Greatly improved 1:100K National Hydrography Dataset (NHD)
- A set of value added attributes to enhance stream network navigation, analysis and display
- An elevation-based catchment for each flowline in the stream network
- Catchment characteristics
- Headwater node areas
- Cumulative drainage area characteristics
- Flow direction, flow accumulation and elevation grids
- Flowline min/max elevations and slopes
- Flow volume & velocity estimates for each flowline in the stream network

Figure 3. NHDPlus Data Web Site <http://www.horizon-systems.com/nhdplus/>



Setting up base layers

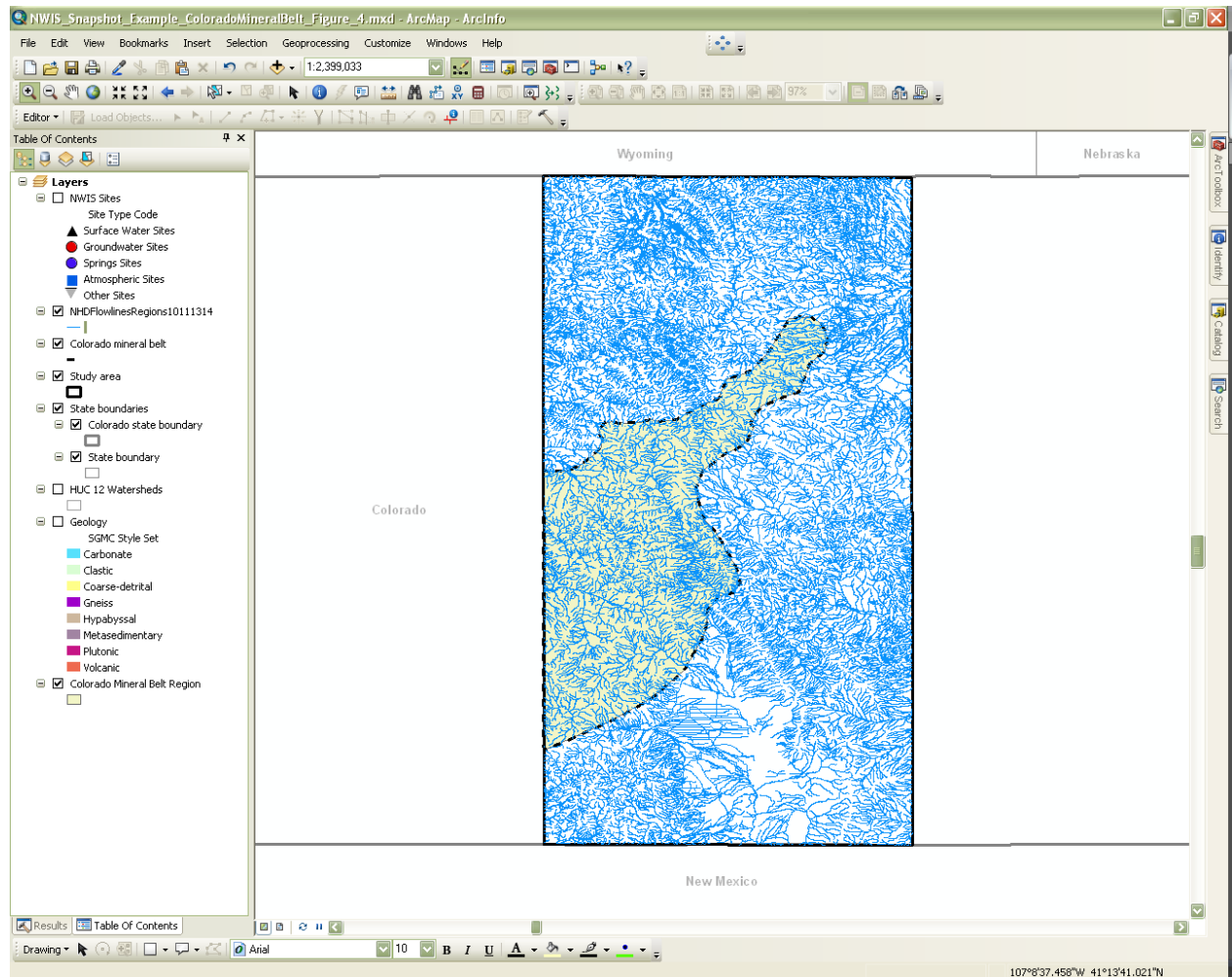
When you download sites for an area using the NWIS Snapshot Tool, you will receive sites for the entire extent of the current “data view” within the ArcGIS session you are using. You may actually want to confine your study to a certain area based on specific criteria. For this case study, we only want to look at sites within the Colorado mineral belt region that are located on Strahler level one and two streams whose headwaters originate in relatively uniform, homogeneous headwater lithologies.

Determining a study area based on specific criteria

- A. Our first criteria for our sites is that they must be on Strahler level one and two streams within our study area. So, we must first determine which streams meet our selection criteria.

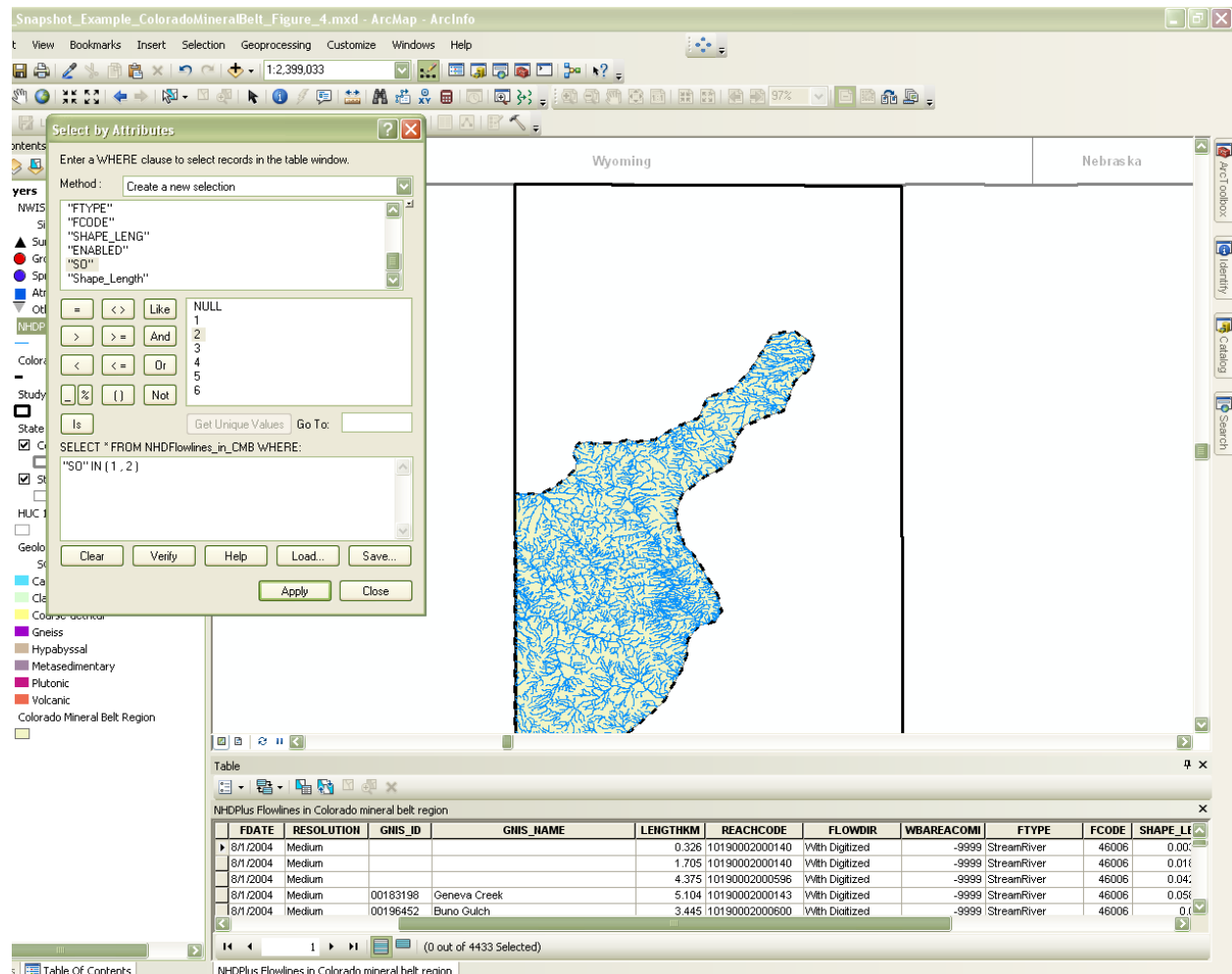
Step 1: Load the NHDPlus stream data into ArcGIS. In this example, the streams are clipped to the study area boundary (Figure 4).

Figure 4. All NHDPlus streams within the Colorado mineral belt study area.



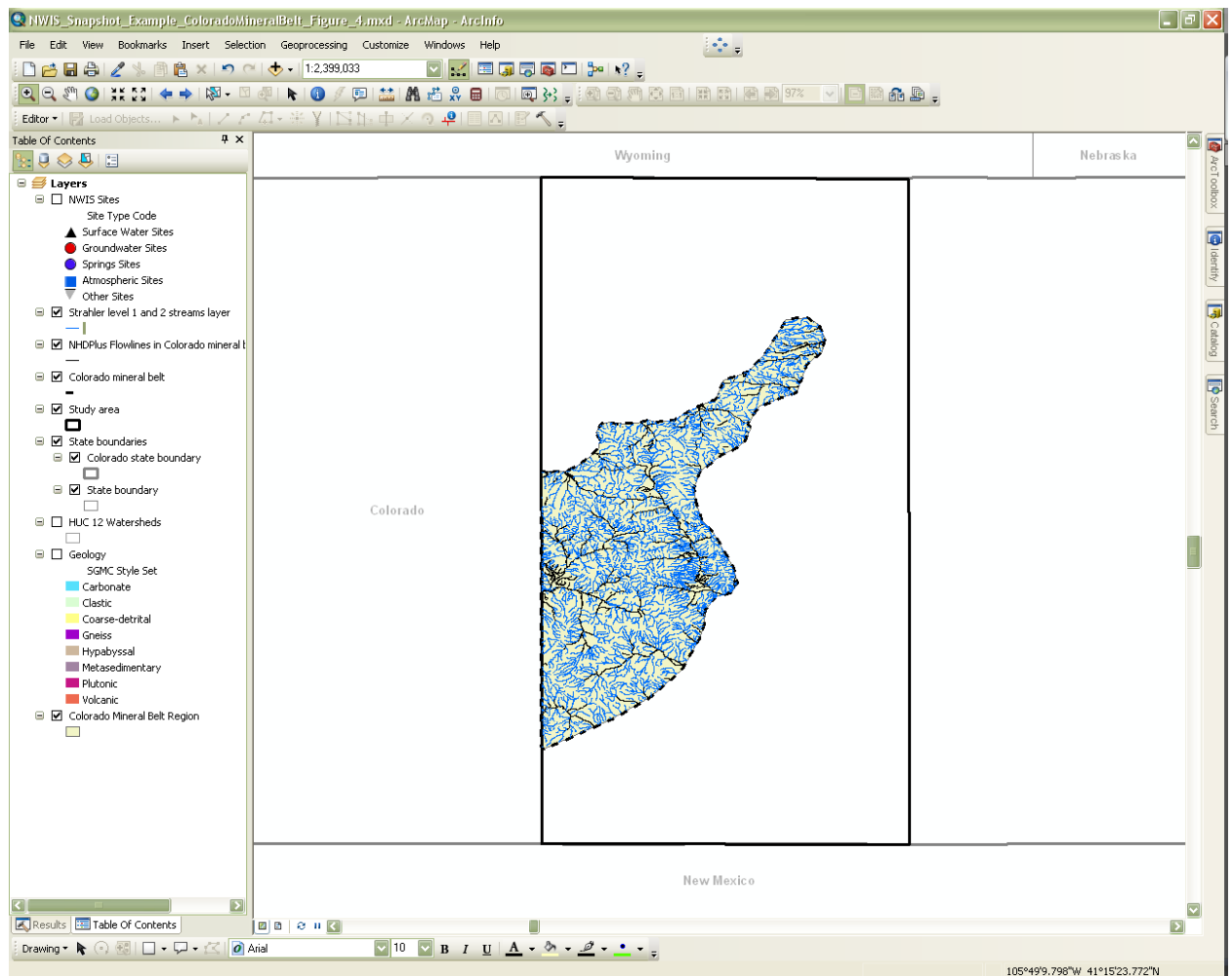
Step 2: Select all Strahler level one and two streams from the flowtable in the NHDPlus database (Figure 5).

Figure 5. Select all Strahler level one and two streams by attributes from the flowtable of NHDPlus.



Step 3: Create a selection layer for the Strahler level one and two streams (Figure 6).

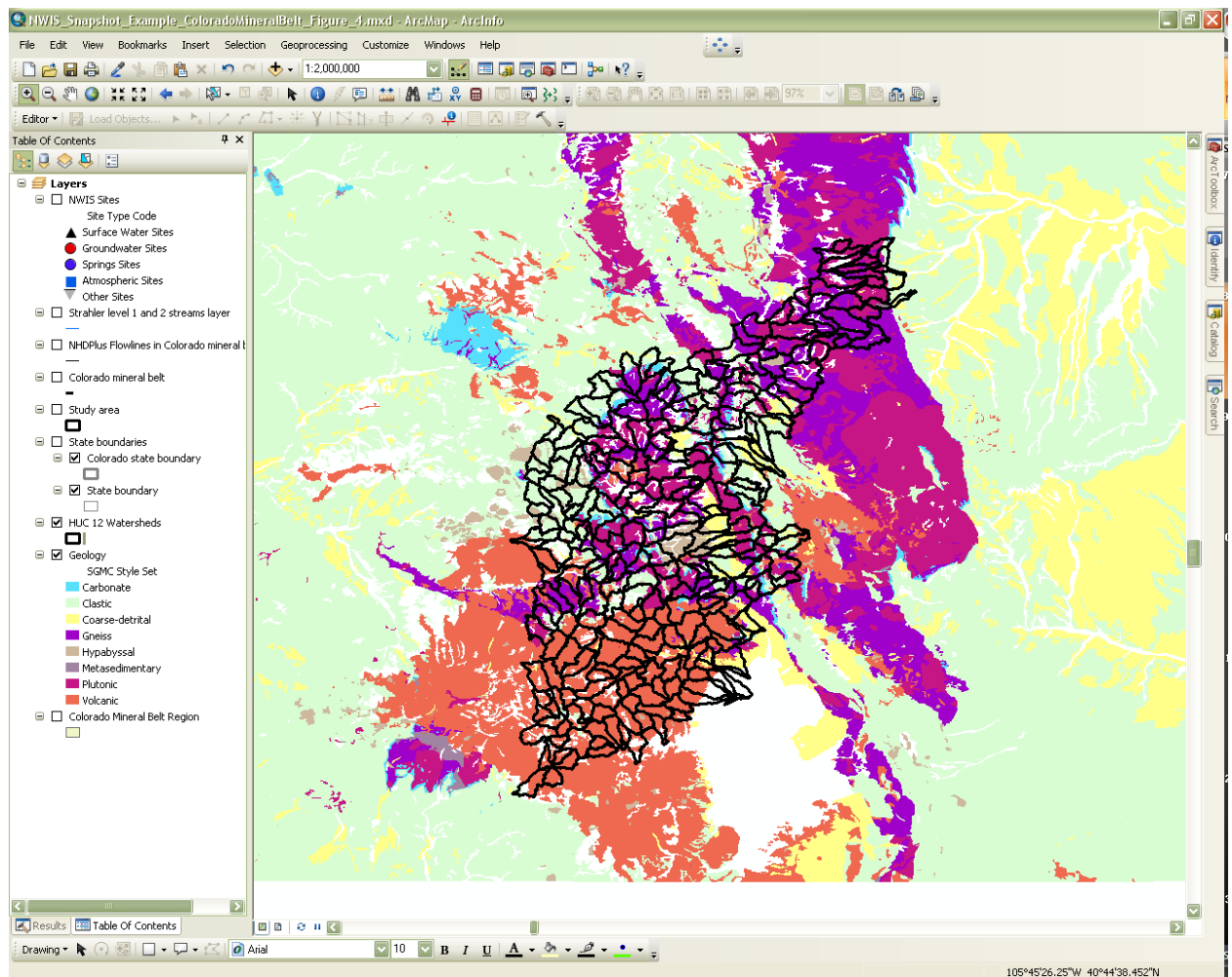
Figure 6. Strahler level one and two selection layer



- B. Our second criteria is that the sites must be on Strahler level one and two streams located in catchments with relatively uniform, homogenous lithology. So we must compare our lithology data to our HUC 12 watersheds (catchments).

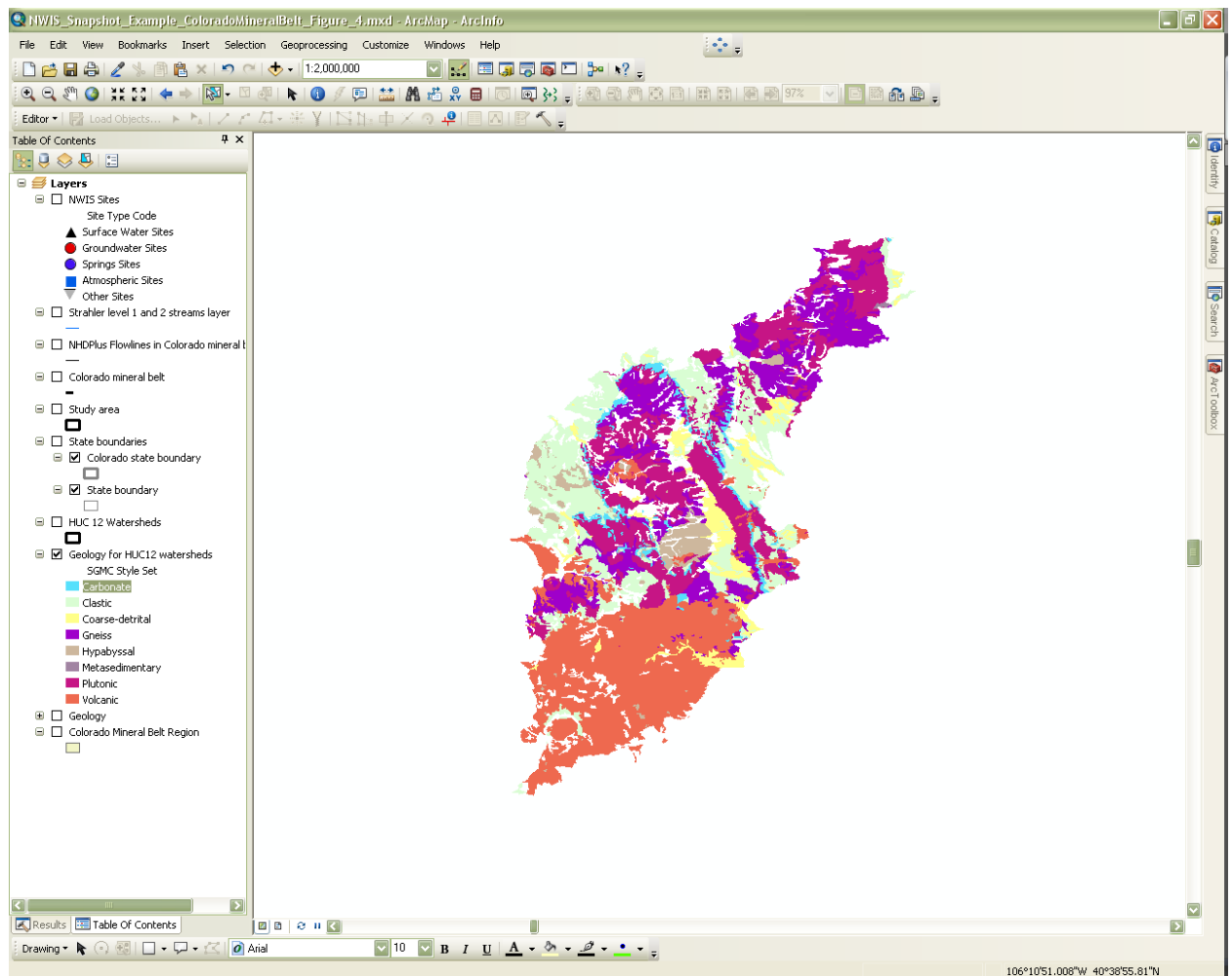
Step 1: Add geologic lithology group data and HUC 12 watersheds to project (Figure 7).

Figure 7. Geologic lithology group data and HUC 12 watersheds.



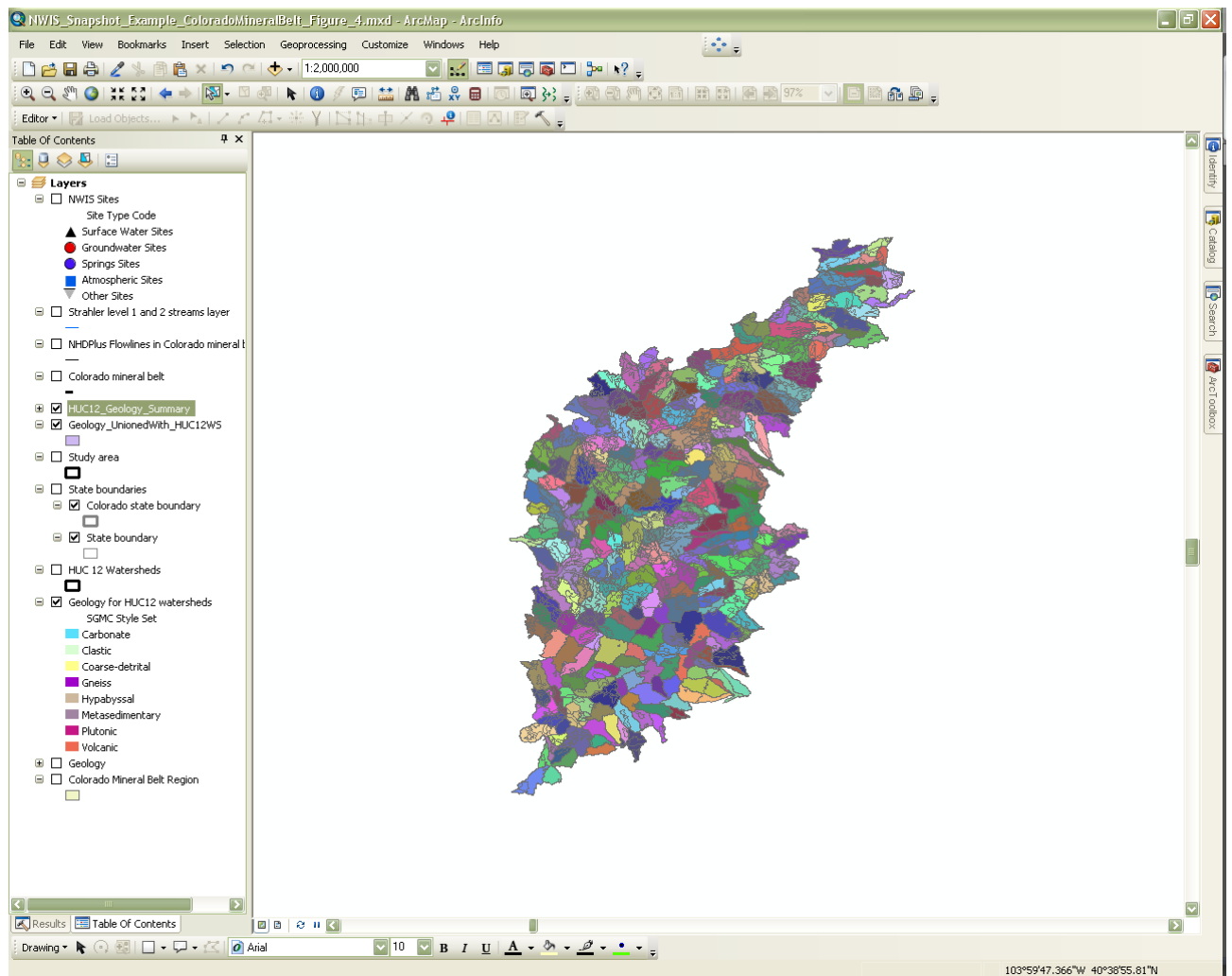
Step 2: Clip lithology by HUC 12 watersheds (Figure 8).

Figure 8. Geology clipped to HUC 12 watershed boundaries for Colorado mineral belt region.



Step 3: Union clipped geology with HUC 12 watershed boundaries (Figure 9).

Figure 9. Geology unioned with HUC 12 boundaries.



Step 4: Dissolve unioned geology by lithology group and HUC 12 value (Figure 10).

Figure 10. Unioned geology dissolved by lithology group and huc 12 code.

OBJECTID *	Shape *	LITH2	HUC_12	Shape_Length	Shape_Area
296	Polygon	Carbonate	140200010106	0.375939	0.000985
297	Polygon	Carbonate	140200010107	0.245615	0.000919
298	Polygon	Carbonate	140200010108	0.151037	0.000304
299	Polygon	Carbonate	140200010109	0.360768	0.001004
300	Polygon	Carbonate	140200010110	0.526048	0.001818
301	Polygon	Carbonate	140200010111	0.666389	0.002813
302	Polygon	Carbonate	140200010112	0.057696	0.000105
303	Polygon	Carbonate	140200010113	0.792912	0.002226
304	Polygon	Carbonate	140200010207	0.423748	0.001314
305	Polygon	Carbonate	140200010209	0.063235	0.000049
306	Polygon	Carbonate	140200010210	0.086162	0.000088
307	Polygon	Carbonate	140200030101	0.174886	0.000361
308	Polygon	Carbonate	140200030102	0.137907	0.000469
309	Polygon	Carbonate	140200030103	0.290406	0.001896
310	Polygon	Carbonate	140200030105	0.052582	0.000133
311	Polygon	Carbonate	140200030301	0.657786	0.001773
312	Polygon	Carbonate	140200030302	0.375672	0.00098
313	Polygon	Carbonate	140200030303	0.380904	0.001069
314	Polygon	Carbonate	140200030304	0.046342	0.000123
315	Polygon	Carbonate	140200030404	0.032772	0.000063
316	Polygon	Clastic	101900010101	0.281268	0.000826
317	Polygon	Clastic	101900010102	0.372598	0.001315
318	Polygon	Clastic	101900010103	0.605343	0.003611
319	Polygon	Clastic	101900010104	0.818783	0.004147
320	Polygon	Clastic	101900010105	0.881665	0.008538
321	Polygon	Clastic	101900010201	0.617376	0.004028
322	Polygon	Clastic	101900010202	0.399673	0.003875
323	Polygon	Clastic	101900010203	0.407496	0.003261
324	Polygon	Clastic	101900010204	0.659047	0.005985
325	Polygon	Clastic	101900010205	1.356872	0.00948
326	Polygon	Clastic	101900010208	0.496726	0.002857
327	Polygon	Clastic	101900010209	1.243818	0.004021
328	Polygon	Clastic	101900010401	0.736725	0.007238
329	Polygon	Clastic	101900010402	1.134524	0.004975
330	Polygon	Clastic	101900010403	0.554327	0.001842
331	Polygon	Clastic	101900010404	0.659413	0.002401
332	Polygon	Clastic	101900050103	0.265229	0.001196
333	Polygon	Clastic	101900050303	0.317179	0.002397
334	Polygon	Clastic	101900050405	0.225007	0.000802
335	Polygon	Clastic	101900050406	0.598363	0.003889
336	Polygon	Clastic	101900050503	0.047124	0.000029
337	Polygon	Clastic	101900050602	0.355249	0.002067
338	Polygon	Clastic	110200010103	0.033586	0.000016
339	Polygon	Clastic	110200010201	0.22078	0.000576
340	Polygon	Clastic	110200010202	1.066876	0.005821
341	Polygon	Clastic	110200010205	0.005674	0
342	Polygon	Clastic	110200010206	0.72691	0.00279
343	Polygon	Clastic	110200010207	0.32466	0.001044
344	Polygon	Clastic	110200010208	0.484747	0.001373
345	Polygon	Clastic	110200010209	0.013628	0.000007
346	Polygon	Clastic	110200010402	0.033959	0.000029
347	Polygon	Clastic	110200010404	0.127268	0.000268
348	Polygon	Clastic	110200010406	0.050449	0.000112
349	Polygon	Clastic	110200010501	0.001474	0
350	Polygon	Clastic	110200010502	0.053111	0.000095

(0 out of 1209 Selected)

HUC12_Geology_Summary

Step 5: Determine area of unioned lithology sections by HUC 12 region, and area of entire HUC 12 region, and then calculate the percentage of total watershed area per lithological group (Figure 11).

Figure 11. Determine the percentage of lithologic type per watershed catchment area.



Step 6: For this project, we will select all sections that are greater than 95% belonging to one lithology group, and consider those as relatively uniform and homogenous lithology (Figure 12).

Figure 12. Select areas of greater than 95% one lithologic group per catchment.

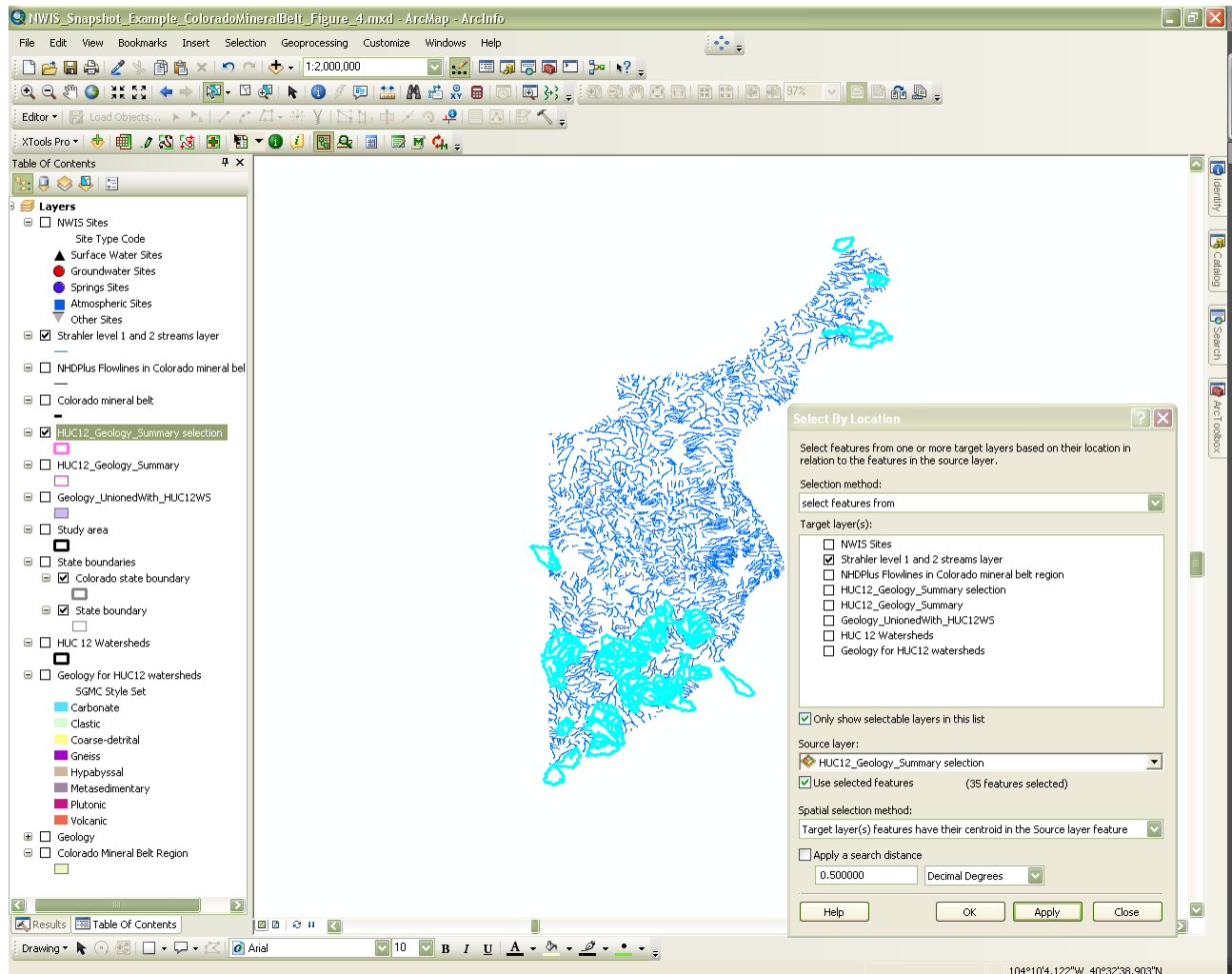
The screenshot displays a GIS application window with a table of catchment data and a 'Select by Attributes' dialog box. The table, titled 'HUC12_Geology_Summary', contains 1209 rows of data. The columns are: OBJECTID, Shape, LITH2, HUC_12, Shape_Length, Shape_Area, EntireWSArea, AreaKM, and PercentLith. The dialog box, titled 'Select by Attributes', shows a WHERE clause: 'PercentLith' >= 95. The status bar at the bottom indicates that 35 out of 1209 records are selected.

OBJECTID	Shape	LITH2	HUC_12	Shape_Length	Shape_Area	EntireWSArea	AreaKM	PercentLith
1136	Polygon	Volcanic	130100040401	0.367645	0.005	48.766886	48.766886	100
1129	Polygon	Volcanic	130100040301	0.427615	0.007948	77.209329	77.209329	100
1143	Polygon	Volcanic	130100040601	0.325255	0.005539	53.974357	53.974357	100
1137	Polygon	Volcanic	130100040402	0.545815	0.0117	114.176289	114.176289	100
1124	Polygon	Volcanic	130100040201	0.403256	0.006118	59.641298	59.641298	100
1120	Polygon	Volcanic	130100040102	0.370165	0.004651	45.307556	45.307559	100
1107	Polygon	Volcanic	130100011105	0.428429	0.005874	57.537108	57.537108	99.999999
1138	Polygon	Volcanic	130100040403	0.406502	0.006811	66.427888	66.427887	99.999999
908	Polygon	Plutonic	101900050404	0.332113	0.004181	39.638879	39.638874	99.999999
1122	Polygon	Volcanic	130100040104	0.325661	0.004269	41.655832	41.642198	99.96727
1096	Polygon	Volcanic	130100010901	0.423176	0.006141	60.212663	60.188954	99.960524
1139	Polygon	Volcanic	130100040404	0.484882	0.006802	66.443061	66.415353	99.956298
1125	Polygon	Volcanic	130100040202			53.97003	65.932537	99.943167
1110	Polygon	Volcanic	130100011301			53.1034	79.403231	99.839304
1184	Polygon	Volcanic	140200030104			740739	62.571580	99.730413
1197	Polygon	Volcanic	140200030504			841785	128.472107	98.945117
1130	Polygon	Volcanic	130100040302			666299	107.63022	98.862773
1177	Polygon	Volcanic	140200020504			988488	92.682198	98.610159
1102	Polygon	Volcanic	130100011004			242367	39.630672	98.479972
1179	Polygon	Volcanic	140200020506			302308	104.612206	98.410098
1171	Polygon	Volcanic	140200020201			104675	83.709045	98.360102
1150	Polygon	Volcanic	130100040701			343789	63.036857	97.968829
1208	Polygon	Volcanic	140801010202			989495	57.769071	97.931116
1126	Polygon	Volcanic	130100040203			595794	59.33187	97.914173
1106	Polygon	Volcanic	130100011008			402968	90.410473	97.843689
1196	Polygon	Volcanic	140200030503			967738	148.651235	97.817627
1094	Polygon	Volcanic	130100010801			923554	71.296108	97.768285
901	Polygon	Plutonic	101900050201			196787	37.340368	97.757878
1132	Polygon	Volcanic	130100040304			107508	49.937376	97.710449
624	Polygon	Gneiss	101900040401			201476	103.666382	97.612939
622	Polygon	Gneiss	101900040207			551679	57.017627	97.380003
1140	Polygon	Volcanic	130100040501			438129	56.863056	97.304717
1134	Polygon	Volcanic	130100040306			812705	132.847607	96.177836
1113	Polygon	<Null>	130100040607			533715	62.479567	95.33458
1105	Polygon	Volcanic	130100011007			243969	40.258599	95.30023
1141	Polygon	Volcanic	130100040502			252917	76.130199	94.862843
1128	Polygon	Volcanic	130100040205			064897	53.122158	94.751192
913	Polygon	Plutonic	101900050503			872029	98.179607	94.519774
426	Polygon	Clastic	140100040302			812533	64.62263	93.911134
1127	Polygon	Volcanic	130100040204			428078	72.671624	92.660214
1131	Polygon	Volcanic	130100040303			837467	71.619167	92.011174
1195	Polygon	Volcanic	140200030502			716344	97.98593	91.435969
935	Polygon	Plutonic	110200010405			862756	90.31969	91.35886
621	Polygon	Gneiss	101900040206	1.111131	0.014918	155.886332	141.833084	90.984939
1200	Polygon	Volcanic	140200030507	0.783828	0.011983	128.927263	116.431389	90.307811
434	Polygon	Clastic	140100040701	0.425509	0.0046	49.361015	44.217926	89.580667
413	Polygon	Clastic	140100030203	0.642377	0.007172	76.495114	68.463357	89.500301
1133	Polygon	Volcanic	130100040305	0.70837	0.008124	88.38583	78.963519	89.339568
620	Polygon	Gneiss	101900040205	0.2914	0.003391	36.212189	32.29027	89.169615
926	Polygon	Plutonic	110200010209	0.355762	0.005409	58.418694	51.927932	88.889238
109	Polygon	<Null>	130100040602	0.290104	0.002075	22.914692	20.233497	88.299232
448	Polygon	Clastic	140200010205	0.656718	0.007961	86.895719	76.629622	88.185314
1108	Polygon	Volcanic	130100011201	0.613184	0.00563	63.02002	55.02639	87.318902
1151	Polygon	Volcanic	130100040702	0.658022	0.007107	79.26926	69.165363	87.253701
1109	Polygon	Volcanic	130100011202	0.602834	0.004101	107.382	88.948043	86.878595

- C. Once we have identified the Strahler level one and two streams within the Colorado mineral belt, and we have determined which catchments are located in areas of relatively uniform, homogenous lithology, we have the necessary components to determine which streams fit all of our criteria. We will now locate all Strahler level one and two streams located in our homogenous catchments.

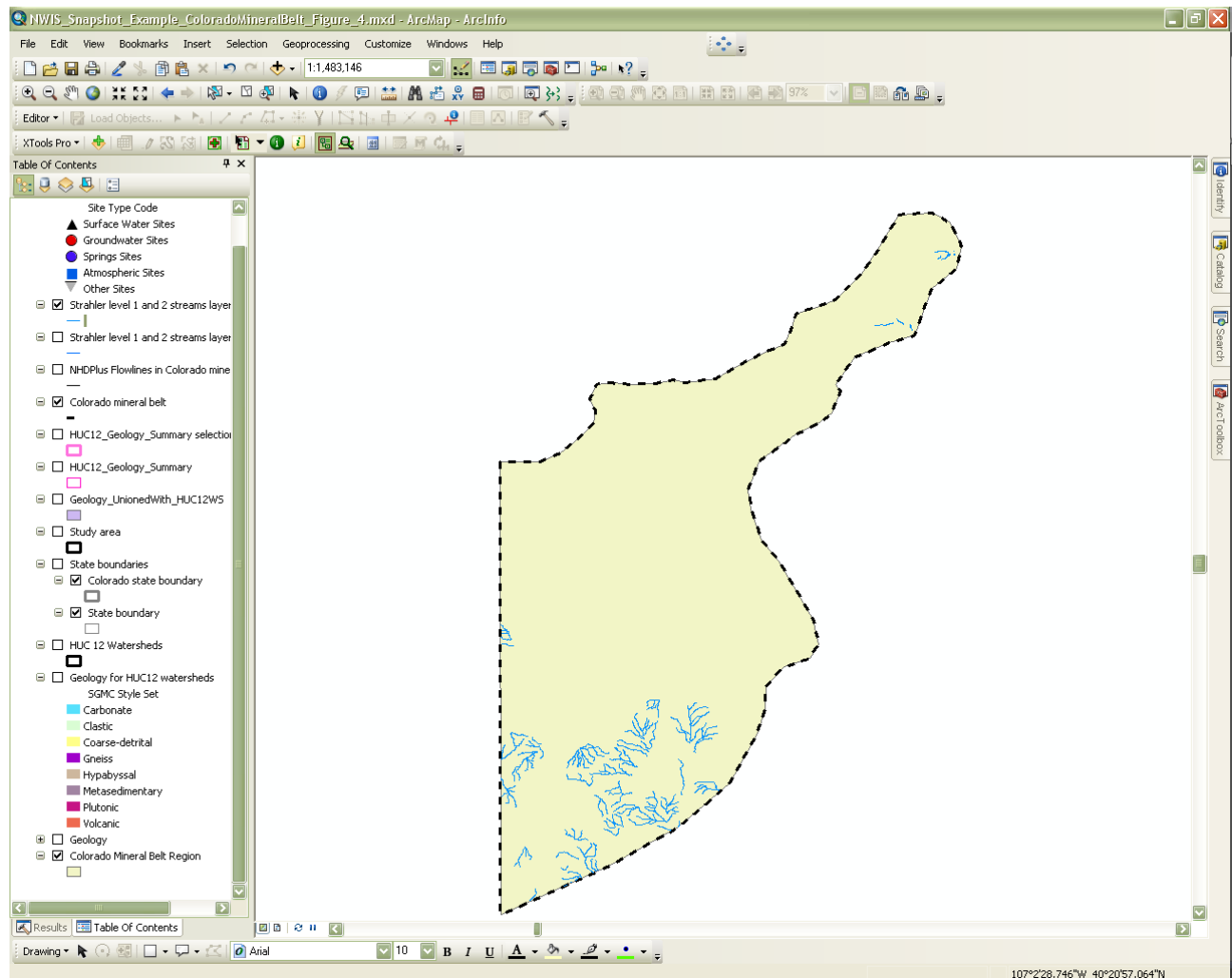
Step 10: Select all Strahler level one and two streams within the selected catchments (Figure 13).

Figure 13. Strahler level one and two streams within homogenous catchments.



Terrific! Now you have all of the Strahler level one and two streams that are located in relatively homogenous catchments, so you can now determine which NWIS Water Quality monitoring stations will contain information pertinent to your study (Figure 14).

Figure 14. All Strahler level one and two streams that are within homogenous catchment areas.



Acquire water quality data for streams of interest

After we have identified the streams we are interested in, we need to obtain water quality information for those streams. For this case study, we are interested in the levels of silver, lead, copper, zinc, found in our streams, and the pH of the water for those streams as well. According to Wanty and co-authors, most of the acidic drainage ($\text{pH} < 5$) sampled in their study resulted from impacts of historical mines, although many natural acid drainages exist.

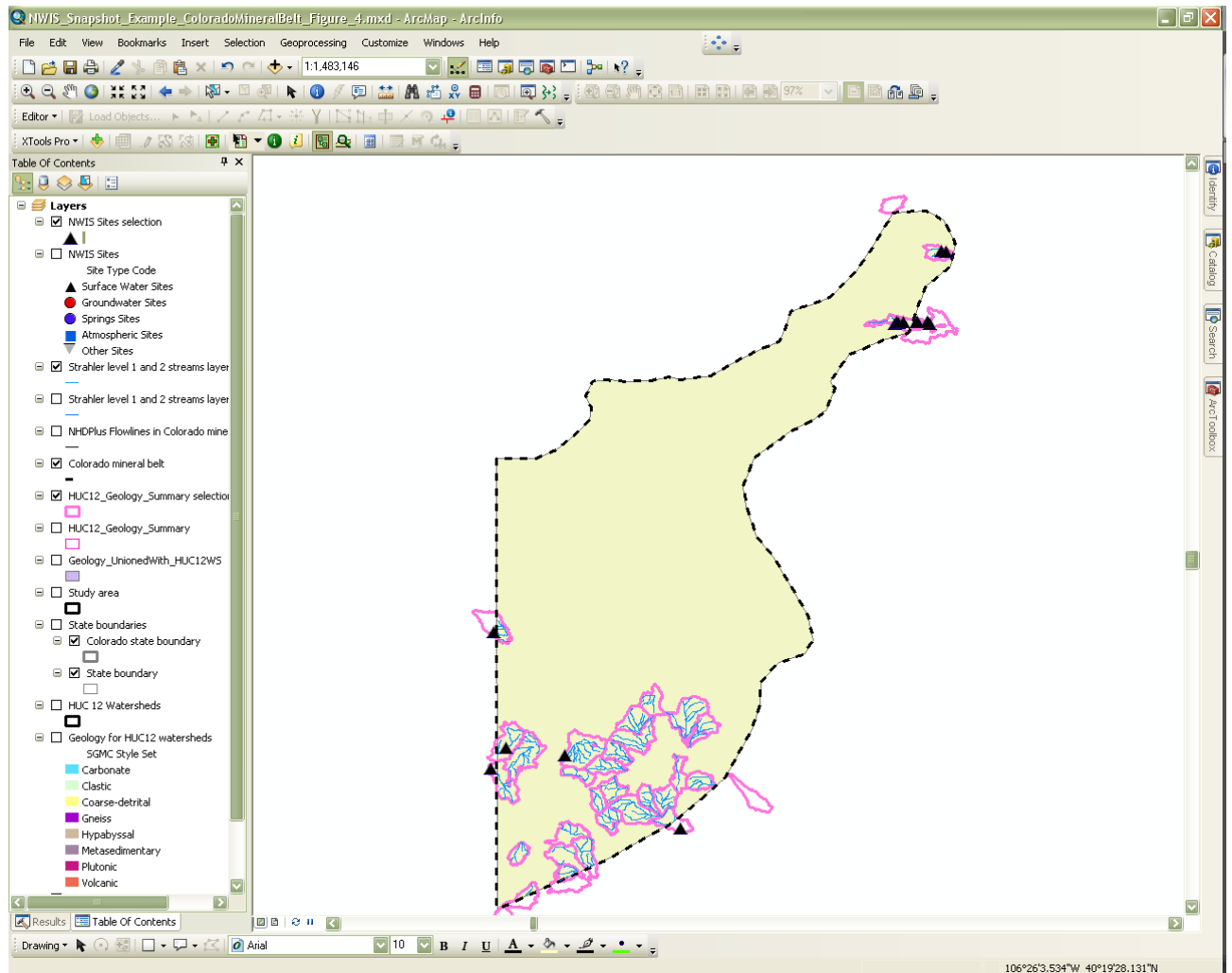
Step 1: Get the surface water sites with water quality data for the extent surrounding the Colorado mineral belt using the Sites tab of the Snapshot NWIS DataService Tool (Figure 15).

Figure 15. Use the NWIS Snapshot tool to load the sites of interest into ArcMap.

The image shows a software window titled "Snapshot NWIS DataService Tool". It has a tabbed interface with "Sites", "Water Quality", "Daily Values", "Unit Values", and "Help". The "Sites" tab is active. Inside the "Sites" tab, there is a section labeled "Include" with three radio buttons: "All Sites" (selected), "Active Sites Only", and "Inactive Sites Only". Below this are two columns of checkboxes. The left column, labeled "For Site Types", includes "All Site Types", "Surface-Water Sites" (checked), "Groundwater Sites", "Spring Sites", "Atmospheric Sites", and "Other Sites". The right column, labeled "With Data Types", includes "All Data Types", "Water Quality" (checked), "Daily Values", and "Unit Values". At the bottom of the configuration area is a button labeled "Get Sites in Current Map Extent". Below the button is a text link: "Visit NWISWeb Site Information at: <http://waterdata.usgs.gov/nwis/si>". At the very bottom of the window is a "Status:" label followed by a progress bar.

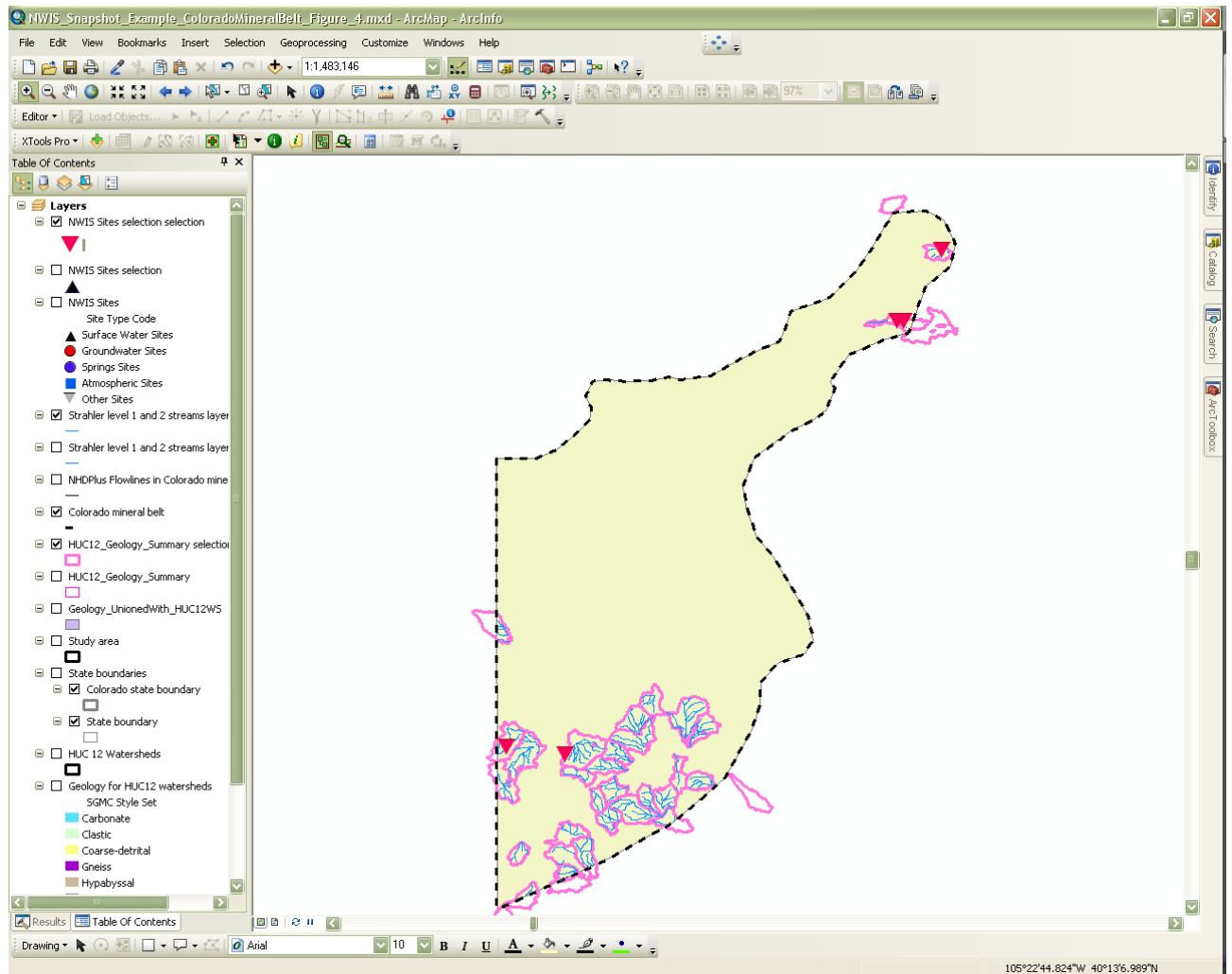
Step 2: Create a selection layer for all NWIS sites that are within our selected catchments (Figure 16).

Figure 16. All NWIS Sites within catchments of interest.



Step 3: Select all NWIS sites located on our level one and two streams (Figure 17).

Figure 17. All NWIS sites on level one and two streams.



Step 4: Use NWIS Snapshot tool to download water quality data for our parameters of interest for the selected sites. Begin by using the parameter code picker tool to select your parameters (Figure 18).

Figure 18. Parameter code picker with Cadmium 01025, Copper 01040, Lead 01049, pH 00400, Silver 01075, Sulfate 00945, and Zinc 01090 selected.

The screenshot shows the 'Parameter Code Picker' window. At the top, there is a search bar with '00945' entered and a dropdown menu set to 'Contains anywhere'. Below the search bar, on the left, is a list of parameter groups with checkboxes, all of which are checked. In the center, a box labeled '1 Matching Parameters:' contains the text 'Sulfate, wf -- Sulfate, water, filtered, milligrams per liter (00945)'. On the right, a box labeled '7 Total Selected:' lists seven parameters: Cadmium, wf -- Cadmium, water, filtered, micrograms per liter (01025); Copper, wf -- Copper, water, filtered, micrograms per liter (01040); Lead, wf -- Lead, water, filtered, micrograms per liter (01049); pH -- pH, water, unfiltered, field, standard units (00400); Silver, wf -- Silver, water, filtered, micrograms per liter (01075); Sulfate, wf -- Sulfate, water, filtered, milligrams per liter (00945); and Zinc, wf -- Zinc, water, filtered, micrograms per liter (01090). At the bottom, there are buttons for 'All', 'Clear', 'Add All', 'Add Selected', 'Clear All', and 'Clear Selected'. A checkbox for 'Show Tool Tips' is checked. At the very bottom, a URL is provided: 'Visit NWISWeb Parameter Code Definitions at: <http://nwis.waterdata.usgs.gov/usa/nwis/pmcodes>'.

Parameter Code Picker

Enter Search Text: 00945 Search Type: Contains anywhere

Choose Parameter Groups:

- ☒ Biological
- ☒ Habitat
- ☒ Information
- ☒ Inorganics, Major Metals
- ☒ Inorganics, Major Non-Metals
- ☒ Inorganics, Minor Metals
- ☒ Inorganics, Minor Non-Metals
- ☒ Microbiological
- ☒ Nutrient
- ☒ Organics, Pesticide
- ☒ Organics, PCBs
- ☒ Organics, Other
- ☒ Physical
- ☒ Population / Community
- ☒ Radiochemical
- ☒ Sediment
- ☒ Stable Isotopes
- ☒ Toxicity
- ☒ Other

1 Matching Parameters:

Sulfate, wf -- Sulfate, water, filtered, milligrams per liter (00945)

7 Total Selected:

Cadmium, wf -- Cadmium, water, filtered, micrograms per liter (01025)
Copper, wf -- Copper, water, filtered, micrograms per liter (01040)
Lead, wf -- Lead, water, filtered, micrograms per liter (01049)
pH -- pH, water, unfiltered, field, standard units (00400)
Silver, wf -- Silver, water, filtered, micrograms per liter (01075)
Sulfate, wf -- Sulfate, water, filtered, milligrams per liter (00945)
Zinc, wf -- Zinc, water, filtered, micrograms per liter (01090)

All Clear Add All Add Selected Clear All Clear Selected

☒ Show Tool Tips

Visit NWISWeb Parameter Code Definitions at: <http://nwis.waterdata.usgs.gov/usa/nwis/pmcodes>

Step 5: Download all water quality data available for these parameters for our sites for the available period of record (0). Note, be sure to change the name of your selection layer to NWIS Sites!

Figure 19. Snapshot tool with settings to download all available data for period of record for our parameters of interest.

The screenshot shows the 'Snapshot NWIS DataService Tool' window. It has a tabbed interface with 'Sites', 'Water Quality', 'Daily Values', 'Unit Values', and 'Help'. The 'Water Quality' tab is active. Under 'Site Selection', 'Request Data for Selected Sites' is selected. Under 'Parameter Codes', a list shows 01025, 01040, 01049, 00400, and 01075, with a 'Count: 7' and an unchecked 'All Parameter Codes' checkbox. 'Date Ranges' shows 'Start Date' as 8/ 9/2011 and 'End Date' as 8/11/2011, with 'All Available for Period of Record' checked. A 'Get QW Data For Sites' button is present. At the bottom, there is a status bar with the text 'Status:'.

Snapshot NWIS DataService Tool

Sites Water Quality Daily Values Unit Values Help

Site Selection

☐ Request Data for All Sites

☒ Request Data for Selected Sites

Parameter Codes

01025
01040
01049
00400
01075

Count: 7

☐ All Parameter Codes

Selection Tool

Top Ten

Date Ranges

Start Date End Date

8/ 9/2011 8/11/2011

☒ All Available for Period of Record

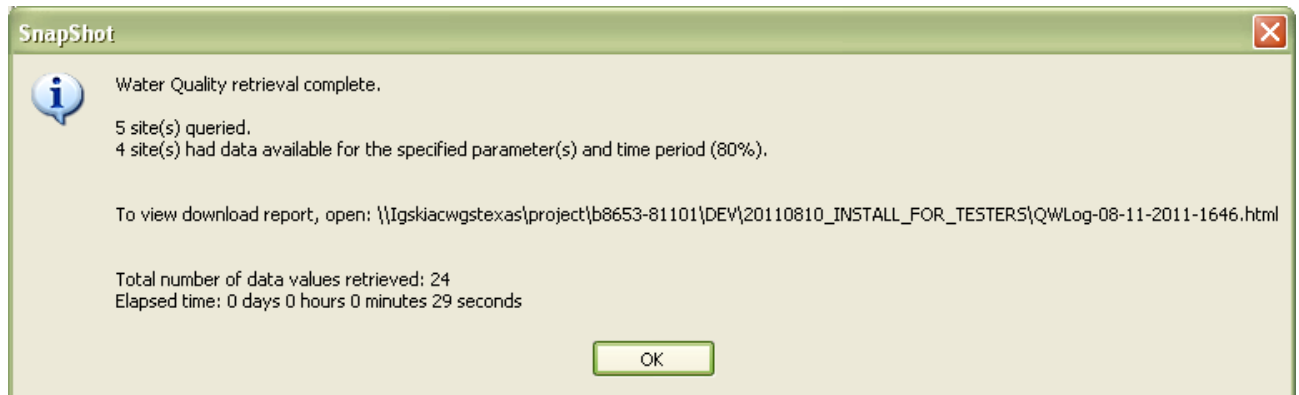
Get QW Data For Sites

Visit NWISWeb Water Quality Data at:
<http://waterdata.usgs.gov/nwis/qw>

Status:

Fantastic! Now we have our water quality data for our sites of interest (Figure 20), and we can move on to changing the look of our data to help us examine it better using a pivot table.

Figure 20. The NWIS Snapshot Tool has downloaded 24 water quality records for our 5 sites, although only 4 of them had data.



How to make a pivot table

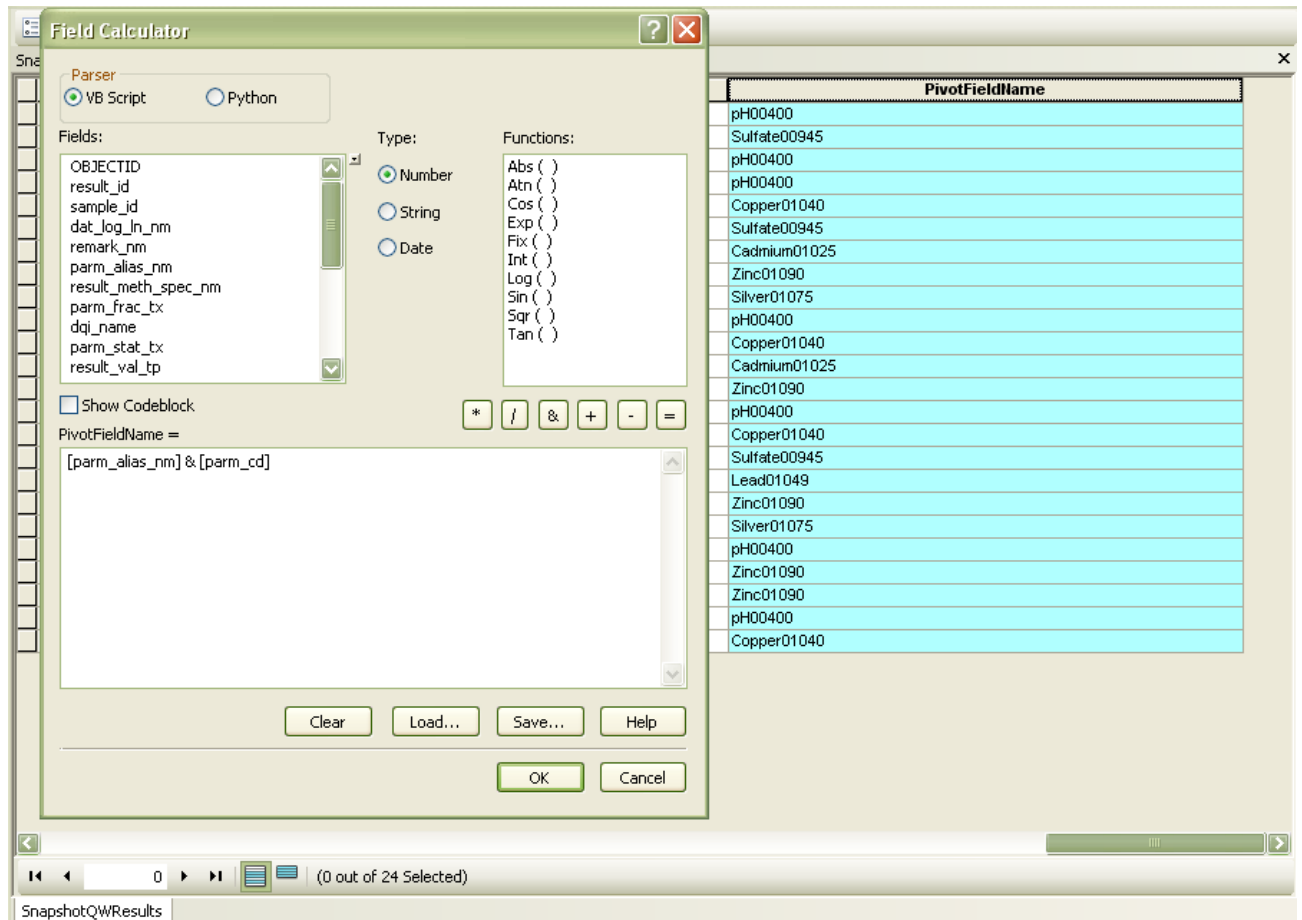
Sometimes you may want to change the arrangement of rows and columns and results in a data table. The NWIS Snapshot tool provides your data in a long table with all of the parameters for each of your sites stacked on top of one another, and if you have a large number of sites and parameters, this might make visually examining your data table a little cumbersome (Figure 21). If you take the parameters and swing them over to become new columns for your sites, with the results next to each site, it may be easier to view the results.

Figure 21. Vertical presentation of water quality data.

io	Parameter Name	M	Sample Fractio	Result Stat	S	Result Valu	Re	Re	R	Re	Result R	USGS P	Result Value	Result Unit
	pH		Total	Historical		Actual					field	00400	9.1	std units
	Sulfate		Dissolved	Historical		Actual						00945	4.7	mg/l
	pH		Total	Historical		Actual					field	00400	8.1	std units
	pH		Total	Historical		Actual					field	00400	3	std units
	Copper		Dissolved	Historical		Actual					field	01040	10000	ug/l
	Sulfate		Dissolved	Historical		Actual					field	00945	1700	mg/l
	Cadmium		Dissolved	Historical		Actual					field	01025	520	ug/l
d	Zinc		Dissolved	Historical		Actual					field	01090	99000	ug/l
d	Silver		Dissolved	Historical		Actual					field	01075	0	ug/l
d	pH		Total	Historical		Actual					field	00400	2.8	std units
d	Copper		Dissolved	Historical		Actual					field	01040	8400	ug/l
ac	Cadmium		Dissolved	Historical		Actual					field	01025	350	ug/l
d	Zinc		Dissolved	Historical		Actual					field	01090	63000	ug/l
	pH		Total	Historical		Actual					field	00400	7.9	std units
	Copper		Dissolved	Historical		Actual					field	01040	20	ug/l
	Sulfate		Dissolved	Historical		Actual					field	00945	83	mg/l
d	Lead		Dissolved	Historical		Actual					field	01049	0	ug/l
d	Zinc		Dissolved	Historical		Actual					field	01090	800	ug/l
d	Silver		Dissolved	Historical		Actual					field	01075	2	ug/l
d	pH		Total	Historical		Actual					field	00400	6.8	std units
ac	Zinc		Dissolved	Historical		Actual					field	01090	660	ug/l
d	Zinc		Dissolved	Historical		Actual					field	01090	190	ug/l
d	pH		Total	Historical		Actual					field	00400	6.9	std units
d	Copper		Dissolved	Historical		Actual					field	01040	20	ug/l

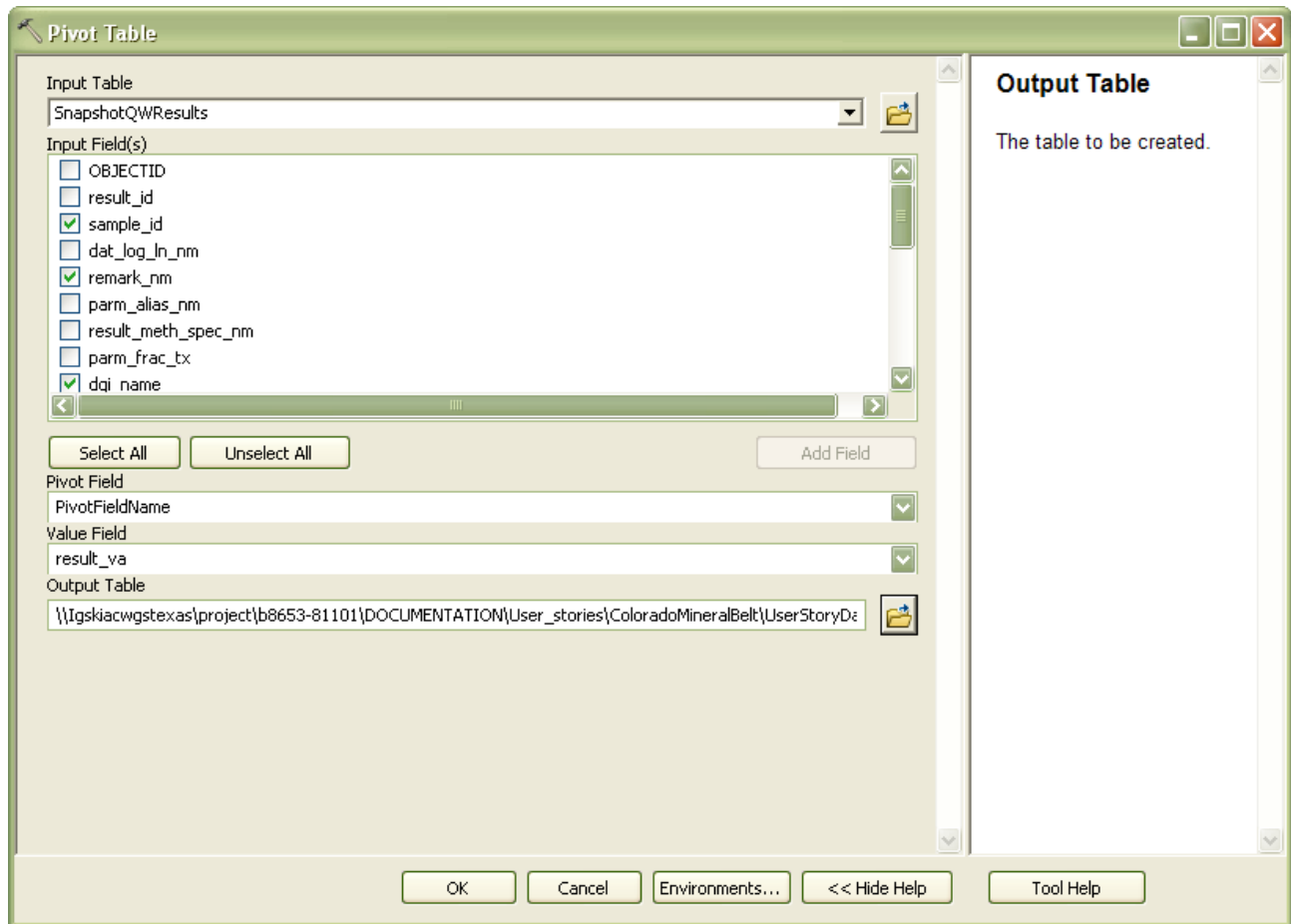
Step 1: Add a new field named “PivotFieldName” to your results table and calculate it to be equal to the parameter name and the parameter code concatenated together (Figure 22).

Figure 22. Calculating names for the PivotFieldName field.



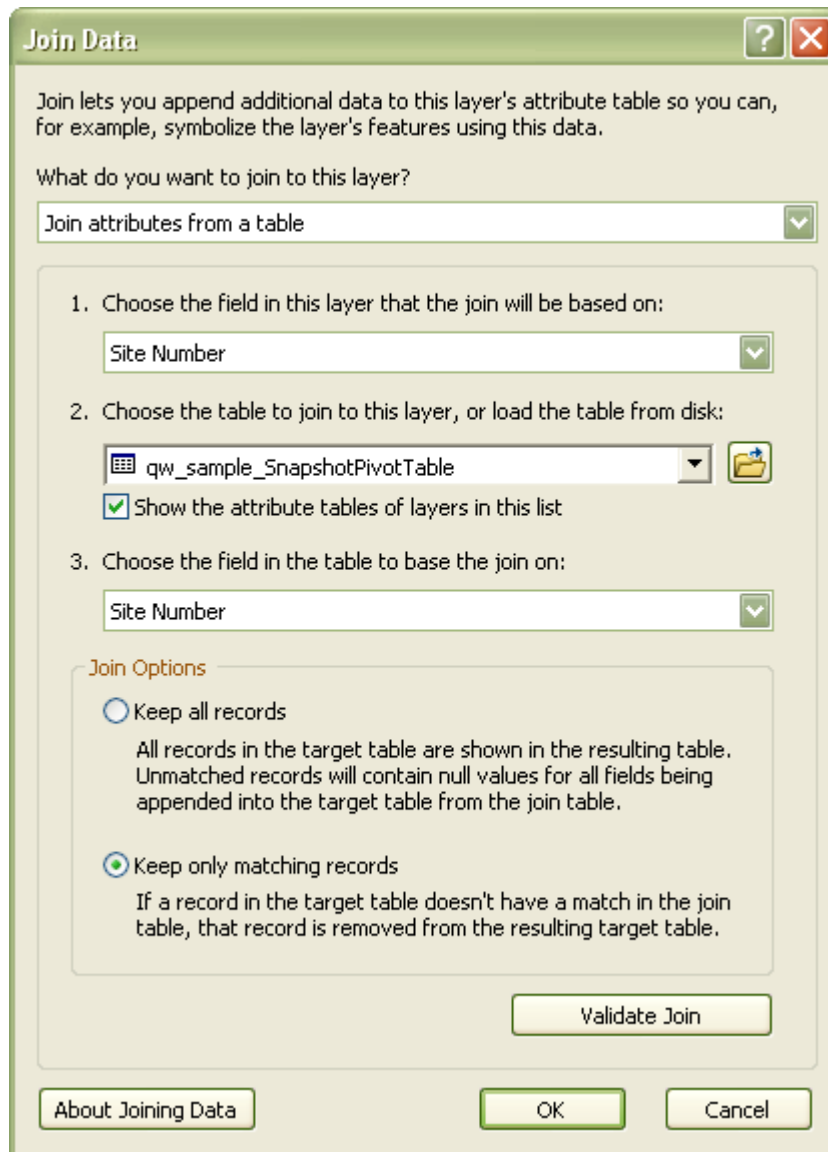
Step 2: Use the ArcMap Pivot Table tool to adjust the arrangement of field, records, and values (0).

Figure 23. ArcMap Pivot Table tool with setting for making a pivot table.



Step 3: Now if you join the NWIS Snapshot Sample table to your pivot table, and then join your selected sites to the joined sample-result table, you can view the water quality for your sites! (Figure 24).

Figure 24. Joining our sites to the samples which have been joined to our pivot table.



At last! You can now see that on December 15, 1971, Virginia Canyon Creek had significant levels of Cadmium, Copper and Sulfate, and a high level of acidity, likely due to mining activities (Figure 25).

Figure 25. Final water quality results for our sites of interest.

Table												
Sites_With_Results												
OBJECTID *	Station Name	Sample St	Result Stat	Result	Resu	Cadmium01025	Copper01040	Lead01049	pH00400	Silver01075	Sulfate00945	Zinc01090
1	ROCK CREEK (ROCK CREEK PARK)	8/20/1981	Historical	Actual	field	0	0	0	9.1	0	0	0
2	VAN TASSEL GULCH (IN UPPER COCHETOPA)	8/24/1978	Historical	Actual		0	0	0	0	0	4.7	0
3	VIRGINIA CANYON C AT MO AT IDAHO SPRGS, CO	12/15/1971	Historical	Actual	field	520	10000	0	3	0	1700	0
4	CLEAR C AB STP OUTFALL @ IDAHO SPRINGS, CO	12/22/1971	Historical	Actual	field	0	20	0	7.9	0	83	0